A Slurp Gun For SCUBA Based Algal Sampling

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ABSTRACT

Vandermeulen, H., M. Wilson, and G. Morton. 2011. A Slurp Gun for SCUBA Based Algal Sampling. Can. Tech. Rep. Fish. Aquat. Sci. 2951: v + 10 p.

The specifications and design of a slurp gun are described for use with SCUBA. The slurp gun uses one-way valves to suck specimens into a collection sock. It is simple to use by divers encumbered by gloves. The slurp gun is particularly good for collecting smaller filamentous algae.

RÉSUMÉ

Vandermeulen, H., M. Wilson, and G. Morton. 2011. A Slurp Gun for SCUBA Based Algal Sampling. Can. Tech. Rep. Fish. Aquat. Sci. 2951: v + 10 p.

Sont décrits les caractéristiques et le modèle d'une pompe d'aspiration aux fins d'utilisation dans le cadre de plongées en scaphandre autonome. La pompe d'aspiration est dotée de clapets de non-retour pour aspirer des échantillons dans un réservoir de collecte. Les plongeurs munis de gants peuvent facilement utiliser cette pompe. La pompe d'aspiration est particulièrement utile pour prélever des échantillons de petites algues filamenteuses.

INTRODUCTION

Slurp guns are routinely used as a hand held device for collecting small fish and invertebrates while SCUBA diving. Slurp guns are essentially giant syringes that capture organisms by suction generated by a plunger in a barrel (Wilcox et al. 1974). A slurp gun is composed of a nozzle and front end cap, a barrel, and a plunger in the barrel moved by a rod (Figure 1). The devices are typically built of clear plastic so that they are almost invisible underwater, an advantage when the nozzle is being pointed at a wary organism for capture. As the plunger rod is pulled back, the plunger moves backwards along the barrel creating a suction that pulls water through the front nozzle, carrying organisms into the barrel (Figure 1).

Note that the typical slurp gun illustrated by Figure 1 has no valves or other devices for holding the sample in the barrel. A determined fish, once collected, could just swim out of the barrel. Also, only one sample can be collected at a time, as moving the plunger back into the pre-deployment position (i.e. next to the front end cap) pushes everything out of the barrel again.

Davies and Ramsey (1989) describe a partial solution to the issues mentioned above by using a one-way valve at the nozzle end of a slurp gun, trapping the specimen in the barrel after deployment. However, their design requires a separate step to transfer the specimen from the barrel to a collection bucket – a rather tedious process for divers encumbered by SCUBA gear.

Interestingly, an earlier publication by Gilligan (1976) solved the specimen collection problem by designing a two valve slurp gun, one stroke to get the specimen into the barrel and a second stroke to push the specimen into a mesh collection bag off the side of the barrel. One-way valves at the nozzle end and barrel opening for the collection bag nurse the movement of the specimen through the slurp gun.

In another version of the two valve idea, Tanner et al. (1977) designed a slurp gun specifically for the problem of collecting small filamentous and other diminutive seaweeds by hand in subtidal locations. Their collection bottle is situated over a one-way valve at the end of a hollow plunger rod. The senior author knew Chris Tanner and Mike Hawkes while at the University of British Columbia and used their slurp gun design in the 1980s.

In this paper, we take the general Tanner at al. (1977) design and modify it to improve performance. Specifically:

- the plunger was made less heavy and its O ring removed (to reduce jamming);
- the construction of the one-way valves was simplified (the glued valves of the 1977 design tend to split);
- the barrel and plunger tube were made larger (to allow for a larger flow-through volume of water);
- the sample collection bottle was replaced by a collection sock (no threading required, simpler to handle with gloves on)

2.0 MATERIALS AND METHODS

Our slurp gun was designed to be compact enough for easy use, while being large enough to capture representative samples of small seaweeds during dive surveys (Figure 2). It is approximately the same overall size as the commercial slurp gun shown in Figure 1. The major components of our slurp gun are manufactured from clear acrylic plastic (as in Tanner et al. 1977).

The design shown in Figure 2 is quite similar to that in Figure 1, but note how the plunger is now hollow in the center – allowing passage of collected materials through the plunger rod (which is now hollow, a plunger tube). This Tanner et al. (1977) design cannot create suction in the barrel by moving the plunger within the barrel unless valves are added (the 'V's in Figure 2).

Our one-way valves were created by using standard 1.75" rubber bicycle inner tubes cut into 7cm lengths. One end of the rubber tube was slipped over the appropriate tube end in the slurp gun (Figures 2, 3, & 4); while the other end of the rubber tube was stapled on either side. The staples flattened the rubber inner tube at this end, allowing water to flow through, but causing the tube to close down if placed under pressure by a reverse flow. Hence, a one-way valve. Although the staples do eventually rust, these valves are much simpler to make and replace than the Tanner et al. (1977) version.

The completed slurp gun is shown assembled in Figure 3. As in Tanner et al. (1977), Plexiglas handles were added on the plunger tube and barrel to ease pumping while wearing diving gloves. However, in our version the handles are simple and clamped in place rather than permanently glued onto the barrel. This allows the handles to be moved or replaced easily.

A lanyard was attached to the barrel to clip to a SCUBA harness when not in use. A ring and elastic cord were added to the valve end of the plunger tube to aid the attachment of a collection sock.

Figure 4 provides some details on the slurp gun. The rear end cap is held onto the barrel by friction and can be removed for barrel cleaning or repairs (Fig. 4A). The front end cap is securely held on the barrel by screws (Fig. 4B).

The plunger has no gasket to seal it against the barrel walls. The plunger is actually relatively 'loose' in the barrel (a clearance of about 1mm). The plunger clearance and lack of gasket were deliberate design options, preventing the plunger from jamming in the barrel due to debris or sand. Jamming was a problem with the Tanner et al. (1977) design.

Figure 4C shows the arrangement of the rear end cap relative to the plunger and its tube. Note how these two parts are attached by surgical tubing held by ring bolts. The surgical tubing is very elastic and stretches as the plunger is pushed into the barrel. Upon release, the tubing pulls the plunger back, creating suction in the barrel which causes water to come in via the nozzle (as in Tanner et al. 1977). With a bit of practice, a diver can create a very strong flow through the barrel, allowing the surgical tubing to do the work on the 'return stroke'.

Figure 4 D & E show the attachment of a collection sock over the rear valve of the plunger tube. Within a couple of plunger strokes, items sucked into the barrel of the slurp gun are pushed through the plunger tube, past its valve, and into the sock. The socks are standard nylon knee high socks, 'Queen Size'. Several specimens can be collected in one sock, or different socks can be used. The diver replaces socks underwater using the elastic cord with loop. Socks can be labeled beforehand. Used socks can be tied closed and placed into a larger standard SCUBA 'goodie bag'. The use of collection socks is an improvement over the Tanner et al. (1977) use of collection bottles with mesh sides, which needed to be screwed on and specimens could be lost while the diver was fiddling with the bottle cap.

Figure 5 is a demonstration of the slurp gun in action, with the collection sock removed for clarity. Notice how the 'specimen' (a piece of *Fucus*) is so rapidly sucked through the barrel that it is just a blur (Fig. 5C). Within a few plunger strokes, the *Fucus* is jetted out of the plunger tube (Fig. 5E).

3.0 RESULTS

The slurp gun has been tested extensively (Figure 6). It is particularly good for collecting 'feathery' algae such as *Ectocarpus*, *Ceramium*, and other filamentous forms. These plants tend to be a bit gelatinous and fragile, breaking apart and sticking to surfaces. If a diver attempted to collect these plants by hand, and place them in a standard goodie bag (the yellow mesh bag held by the diver on the left in Figure 6), much of the material would fragment and drift away while the material in the bag would either fall through the mesh or stick to it in a tangled mess.

We used the slurp guns in an extensive algal survey in Cape Breton (Isle Madame area) in the summer of 2010. The slurp guns are quite robust and withstand the abuse associated with SCUBA gear on deck.

DISCUSSION

Our slurp gun design is simple, efficient and easy to modify or repair. It is an improvement over the Tanner et al. (1977) design. It works well for collecting difficult to handle smaller algae, and should also serve for collecting small invertebrates and fish.

ACKNOWLEDGMENTS

Scott Seamone tested the slurp guns and assisted with the Isle Madame survey. As always, the staff working in the BIO shops did a superb job of turning paper plans into reality.

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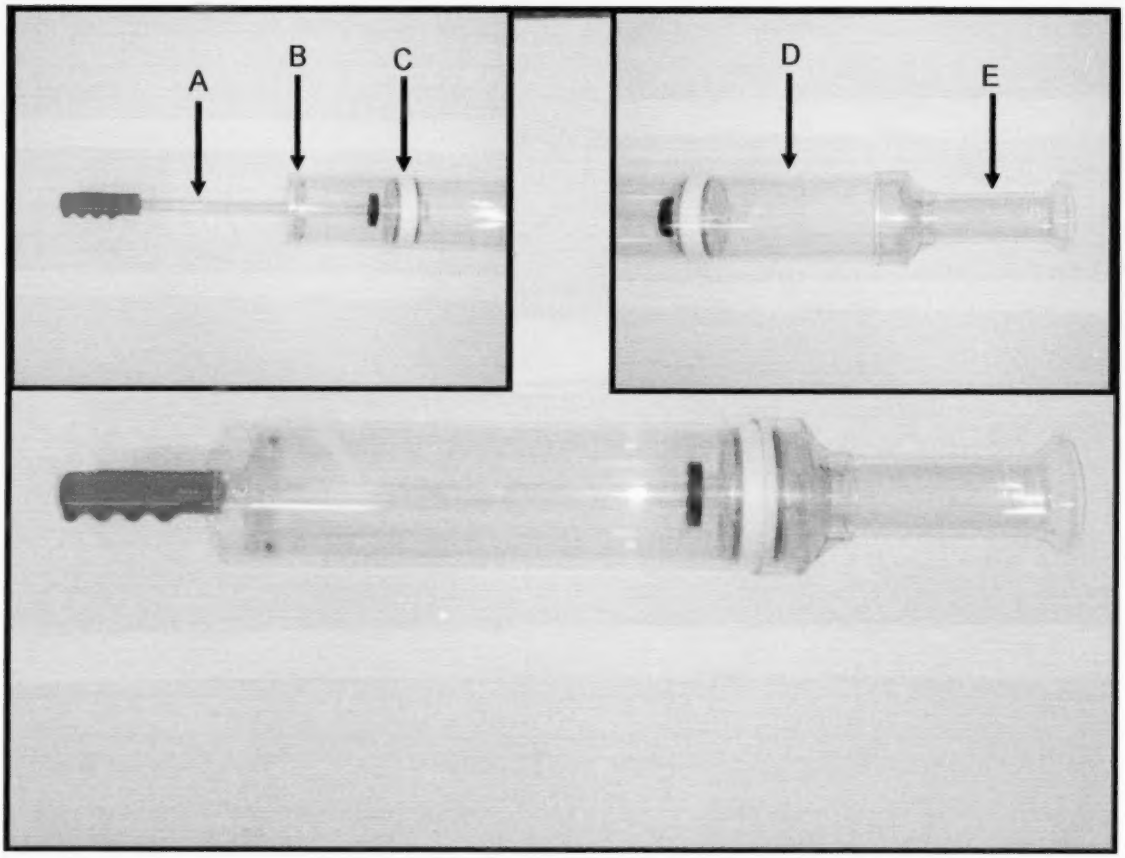

Figure 1: Typical commercial slurp gun for SCUBA use. **Main image** – plunger rod pushed in, ready to deploy. **Inserts** – plunger rod pulled back, deployed. **A** – Plunger rod (39cm long), **B** – rear end cap (8cm diameter, has openings for water flow), **C** – plunger, **D** – barrel (30cm long), **E** – front end cap and nozzle (13cm long, 5cm diameter).

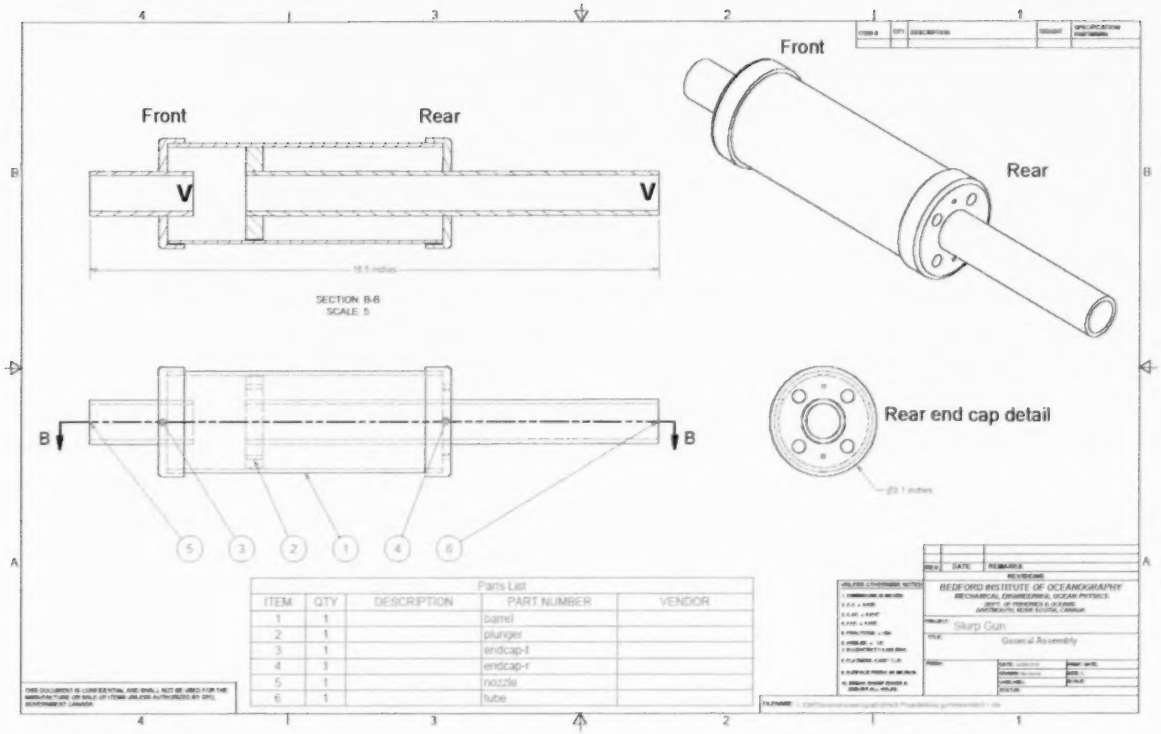

Figure 2: Design of our slurp gun. Similar to the commercial version in Figure 1, note how the rear end cap (item #4) has four holes drilled in it to allow for water flow through while the front end cap is solid (to hold water in that portion of the barrel between it and the front of the plunger). V = position of one-way valves (modified bicycle inner tubes).

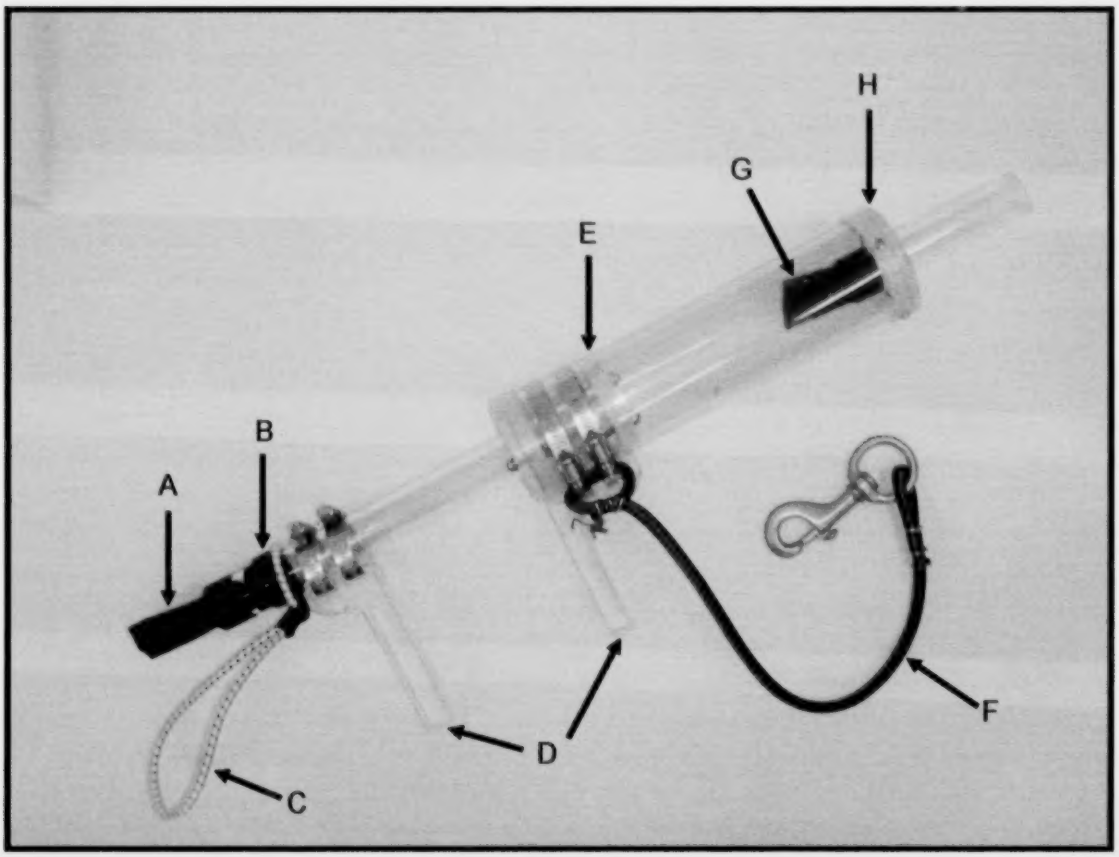

Figure 3: Competed slurp gun. **A** – one-way valve on end of plunger tube, **B** – ring around plunger tube to align elastic cord, **C** – elastic cord and loop to hold collection sock, **D** – Plexiglas handles on plunger tube and barrel, **E** – plunger in barrel, **F** – lanyard to clip to diver when not in use, **G** – one-way valve on inside end of nozzle, **H** – front end cap (screwed into barrel) with nozzle.

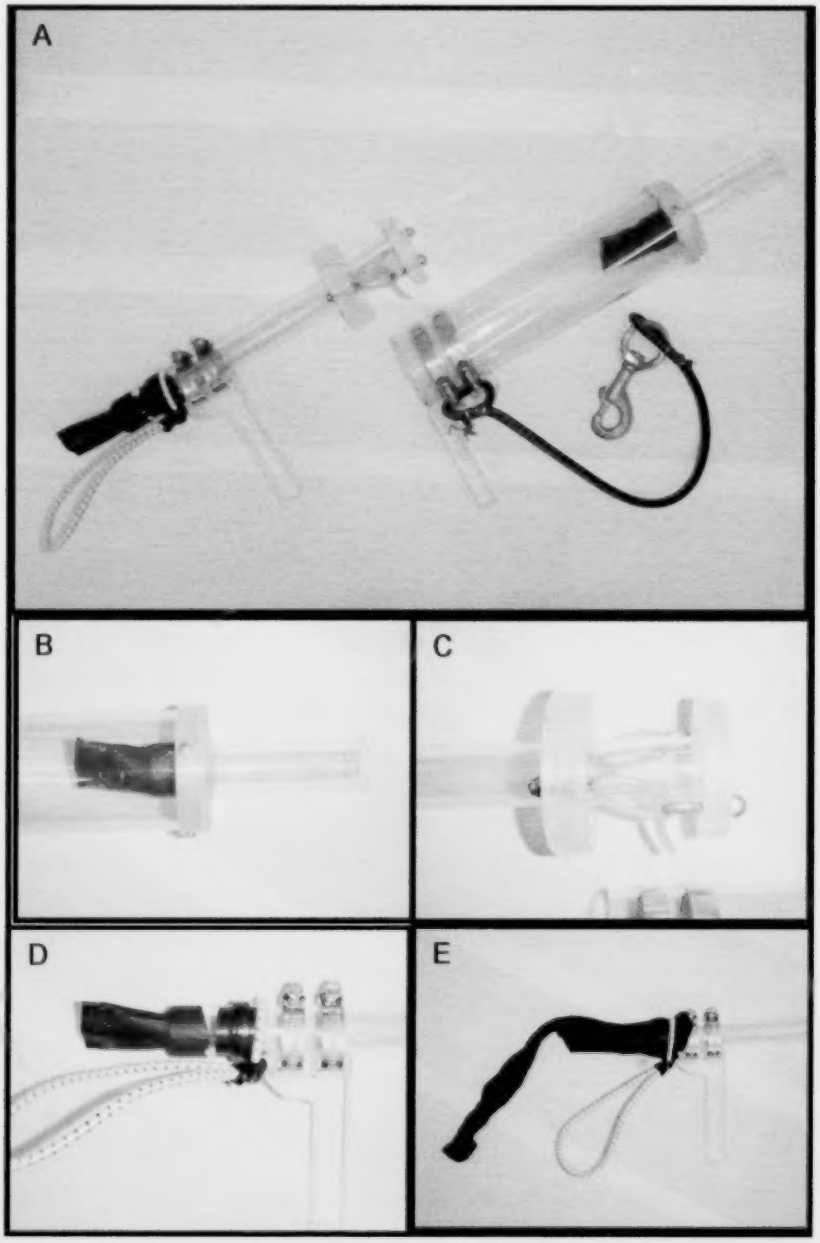

Figure 4: Slurp gun details. **A** – Rear end cap (and associated plunger tube and plunger) pulled off of barrel, **B** – detail of front end cap with screws, nozzle and associated one-way valve, **C** – detail of plunger and rear end cap held together by surgical tubing attached to ring bolts, **D** – detail of rear end of plunger tube, with raised black ring and associated elastic cord, **E** – same section, but with collection sock added, covering the one-way valve.

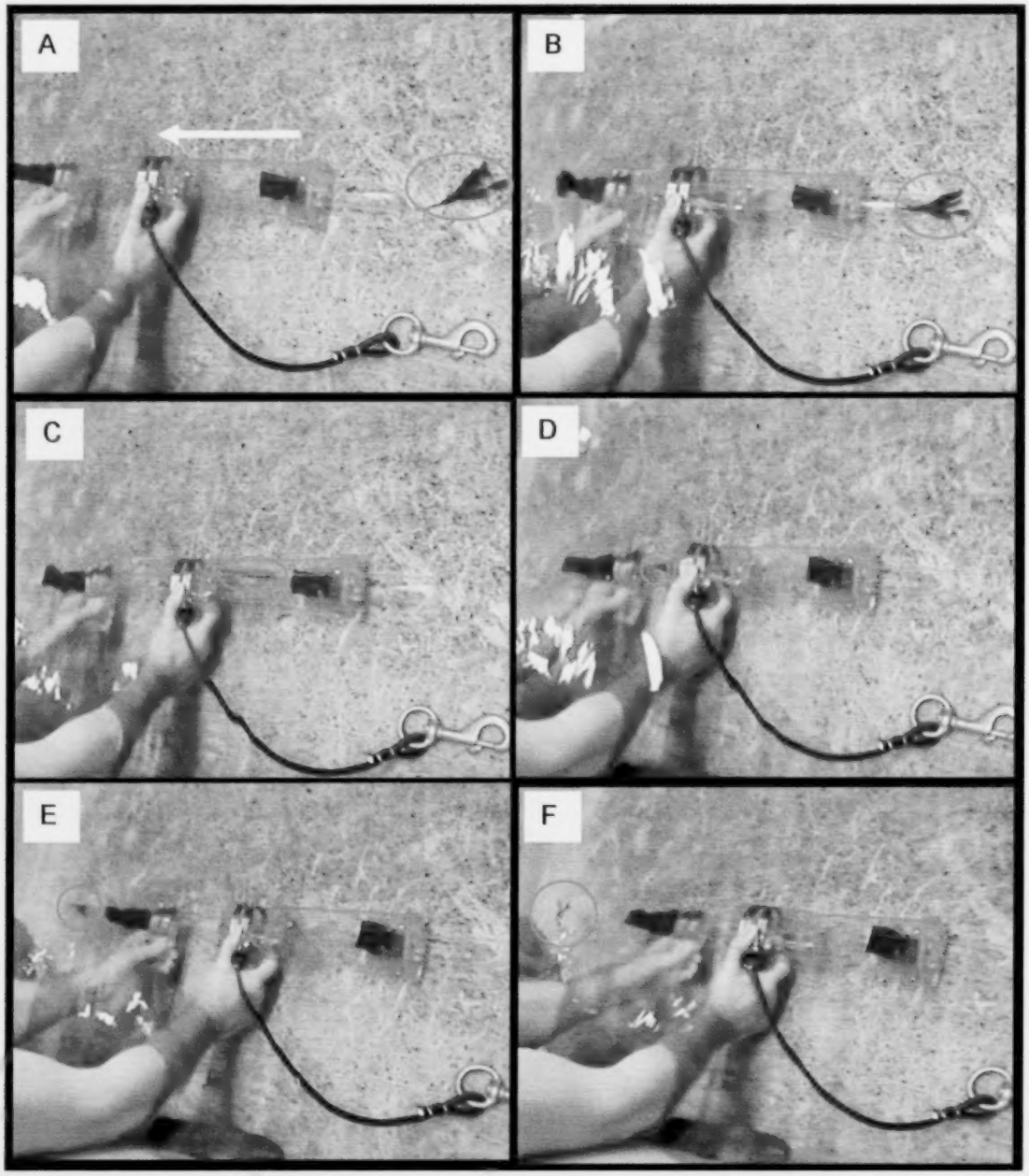

Figure 5: Slurp gun in use in experimental tank. **A** – Operator holds barrel in place with right hand while rapidly pumping plunger tube towards the nozzle end (front) of the barrel with left hand. The surgical tubing pulls the plunger back towards the rear of the barrel with each pump. With this action, and the one way valves, a strong water flow is created in the barrel in the direction of the white arrow. Note piece of *Fucus* (red circle) near the nozzle of the slurp gun. **B** – The slurp gun suction pulls the *Fucus* into the nozzle. **C** – *Fucus* rapidly forced into barrel area. **D** – *Fucus* passing through plunger tube. **E** – *Fucus* jetting out of slurp gun through plunger tube one-way valve (it would normally be caught in the collection sock at this point). **F** – *Fucus* re-expands to normal shape at end of the tank.

Figure 6: Testing the slurp guns on a dive. The feathery yellow filamentous algae on the bottom (and drifting in the water) would normally be very difficult to sample by hand. With the slurp gun, the divers only need to aim and pump to get a sample.